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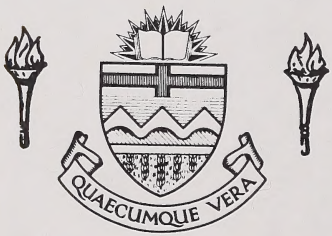

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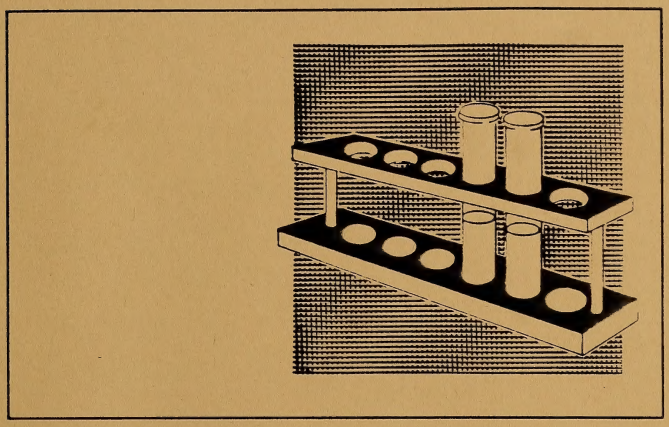

Student Achievement Testing Program

Grade 9 Science

This bulletin contains general information about the 1985 Student Achievement Testing Program and information specific to the Grade 9 Science Achievement Test. Additional copies of this bulletin may be obtained by telephoning 427-2948.

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PURPOSE OF THE BULLETIN

The Grade 9 Science Achievement Test will be written on June 11, 1985. This bulletin provides a general description of the achievement test, an outline of the objectives to be tested, the test blueprint, and sample questions that demonstrate the nature and complexity of the test items.

Teachers are encouraged to prepare their students for the achievement test by having them work through the sample questions.

Teachers should also refer to the publication *Grade 9 Science Curriculum Specifications* (July 1981), which presents the specific content and objectives from which the test questions are developed.

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Purpose of the Achievement Testing Program

The purpose of the Achievement Testing Program is to provide educators, trustees, and others with information, significant at the provincial and local levels, about student knowledge, understanding, and skills in relation to program objectives. The achievement tests are administered on a cyclical basis in four subject areas: language arts, social studies, mathematics, and science, and at three grade levels: 3, 6, and 9.

Nature of the Achievement Testing Program

The achievement tests are specific to the program of studies prescribed by the Minister of Education. Curriculum specifications for each subject area, provided by the Curriculum Branch and the Language Services Branch of Alberta Education, identify the major content areas, the specific learning objectives within each area, and the emphasis that each objective is to receive. The test questions reflect these curriculum specifications.

Classroom teachers from across the province are extensively involved in developing and field-testing the questions. After field-testing, the student responses are analysed to determine the discriminating power and difficulty level of the questions. Questions may undergo several revisions before they appear on the achievement test.

The final draft of each test is examined by a Technical Review Committee that includes representatives of The Alberta Teachers' Association, the Conference of Alberta School Superintendents, Alberta's post-secondary institutions, and Alberta Education.

Students Tested

The results of the Achievement Testing Program are significant at the school jurisdiction level. Excepting the large urban school districts, total population testing is required to obtain significant results. Where possible, sampling may be done by using the school as a sample unit if the school jurisdiction so requests on or before April 1, 1985.

Exemptions from the Achievement Testing Program

Under normal circumstances, the following are exempt from achievement testing:

- Students for whom grants are received from the Special Educational Services Branch
- Students in classes in which the subject being tested has been cycled and taught in an alternate year

- Students in classes in which the subject being tested has been taught in an alternate semester
- Students enrolled in English as a Second Language programs for whom grants are received under Section 54(2) of the *School Grants Regulations*

All exemptions must be approved by the school superintendent.

Students Receiving Instruction in a Language Other Than English

Mathematics, Science, and Social Studies. Students in grades 3, 6, and 9 who are being taught mathematics, science, or social studies in a language other than English are exempt from writing the achievement test in that subject.

English Language Arts. Students who are being taught in a language other than English will be exempt from writing the English language arts achievement test at the Grade 3 level, but will be required to write the test at the grades 6 and 9 levels.

However, as a service to school jurisdictions, French language arts achievement tests and French translations of the mathematics, science, and social studies achievement tests at the grades 6 and 9 levels are available on request. In 1985, French translations of the Grade 6 Social Studies and the Grade 9 Science achievement tests will be prepared.

Alberta Education will score the Grade 9 Science test and the multiple-choice portion of the Grade 6 Social Studies test. A scoring guide will be provided for the written-response portion of the Grade 6 Social Studies test.

Administration of the Achievement Testing Program

The Achievement Testing Program is administered in accordance with *Examination Regulation 531/82* pursuant to Section 11(1)(g) of the *School Act*.

During 1985 and 1986, the achievement tests will be administered according to the following schedule:

June 11, 1985		June 10, 1986	
Grade 3	Language Arts (English)	Grade 3	Mathematics
Grade 6	Social Studies	Grade 6	Science
Grade 9	Science	Grade 9	Language Arts (English)

Reporting the Achievement Test Results

The provincial report will include only provincial profiles of student achievement and will reflect the major components of each test. Each jurisdiction will also receive a district profile of student achievement to parallel the provincial report, as well as guidelines for interpreting the jurisdictional results in relation to provincial norms. Alberta Education will not issue individual statements of results to students, but individual student profiles will be returned to the appropriate Superintendent of Schools. The superintendent and the school board will determine the distribution of information about achievement at the local level.

Because of the small number of students involved, no provincial reports will be prepared for the French translations of the tests.

The results of the 1985 Student Achievement Testing Program will be available in October 1985.

DESCRIPTION OF THE GRADE 9 SCIENCE ACHIEVEMENT TEST

General Format

The time allotted for writing the Grade 9 Science Achievement Test is one and one-half hours.

The test consists of 75 multiple-choice questions which are answered on machine-scorable answer sheets.

Students must bring HB pencils and erasers. Calculators are not required for successful completion of the test. However, any student who wishes to use a calculator may do so.

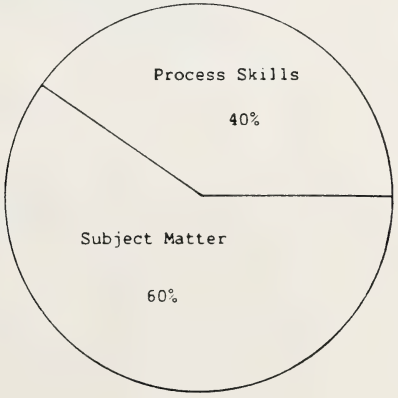
Content

The four major components of the Grade 9 Science curriculum and the emphasis that each is to receive according to the *Grade 9 Science Curriculum Specifications* (July 1981) form the basis for the achievement test. These are:

Component	Emphasis
Process Skills	30%
Psychomotor Skills	10%
Attitudes	10%
Subject Matter	50%

The scope of the Grade 9 Science Achievement Test is of course limited to those objectives that may be efficiently tested using paper and pencil. While some questions on the test may reflect the psychomotor skills component, basically it is the process skills and subject matter components of the curriculum that are tested. The psychomotor skills and attitudinal components will be reflected in the teacher's evaluation of students.

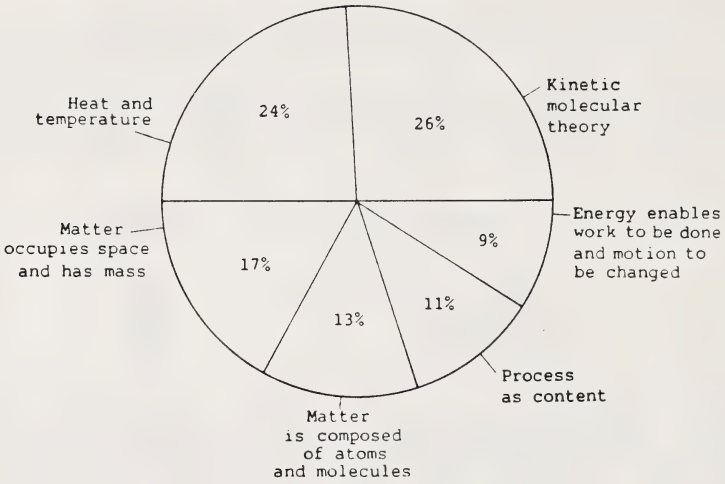
The emphasis given to the process skills and subject matter components are shown in the pie chart below.



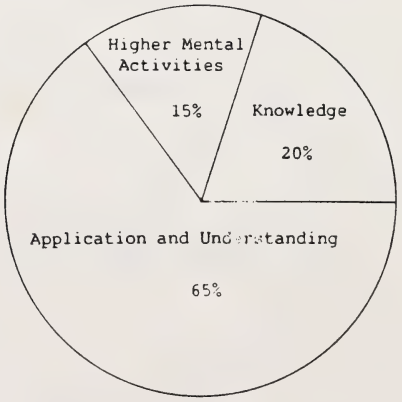
The subject matter component is divided into five subtests to reflect the subdivisions in the Grade 9 Science core. These subdivisions are listed below

9.1 Matter occupies space and has mass
9.2 Kinetic molecular theory
9.3 Heat and temperature
9.4 Energy enables work to be done and motion to be changed
9.5 Matter is composed of atoms and molecules

The process skills component is divided into two parts: process integrated with subject matter and process as content. Questions based on the latter comprise the sixth subtest. The emphasis given to each subtest is shown in the pie chart below.



The test questions represent three cognitive levels: knowledge, application and understanding, and higher mental activities. An explanation of these terms is given in the appendix. The emphasis given to each cognitive level is shown in the pie chart below.



Blueprint for the Achievement Test

Distribution of Questions by Percentage of Total Mark

SUBTEST[1]	PROCESS SKILLS[2]	COGNITIVE LEVELS[3] 1	2	3	TOTAL
Matter occupies space	6	4	11	2	17
Kinetic molecular theory	8	5	17	4	26
Heat and temperature	8	5	15	4	24
Energy	3	2	6	1	9
Atoms and molecules	4	2	9	2	13
Process skills as content	11	2	7	2	11
TOTAL	40	20	65	15	100

[1]Subtest descriptions have been shortened in this table.

[2]This column indicates the percentage of test questions in which process skills are integrated with subject matter.

[3]See appendix.

Sample Questions

Use the following information to answer question 1.

Liquid	Mass (kg)	Volume (m^3)
methyl alcohol	16 200	20
sea water	51 250	50
water	30 000	30
heavy water	11 050	10

1. Which of the following statements is correct?

   A. Water will float on methyl alcohol.
   B. Heavy water will float on sea water.
   *C. Sea water will float on heavy water but not on water.
   D. Methyl alcohol will float on heavy water but not on water.

In this question the student is required to process data and to evaluate conclusions based on data related to subdivision 9.1.

2. A student pours sand into a graduated cylinder up to the 40.0 mL mark. He then adds 30.0 mL of water to the cylinder. The sand and water together come to the 55.2 mL mark in the cylinder. The volume of the spaces between the sand particles must be

   *A. 14.8 mL
   B. 15.2 mL
   C. 25.2 mL
   D. 70.0 mL

In this question the student is required to apply principles related to subdivision 9.1.

3. What effect does evaporation have on the temperature of a substance?

   A. The temperature increases.
   *B. The temperature decreases.
   C. The temperature stays the same.
   D. The temperature decreases or increases depending on the substance.

In this question the student is required to recall knowledge related to subdivision 9.2.

---

*denotes correct answer

Use the following information to answer question 4.

> A student leaves a beaker containing 6.0 g of salt dissolved in 20.0 g of water in the sun. After a period of time she finds that the mass of the solution has decreased by 12.0 g due to evaporation.

4. What is in the remaining 14.0 g of solution?

   A. 14.0 g of water only
   *B. 6.0 g of salt and 8.0 g of water
   C. 3.0 g of salt and 11.0 g of water
   D. Less than 1.5 g of salt and 12.5 g of water

In this question the student is required to apply principles related to subdivision 9.2.

5. The temperature of a substance is determined by the

   A. total mass of the substance
   B. molecular structure of the substance
   C. total kinetic energy of the molecules
   *D. average kinetic energy of the molecules

In this question the student is required to recall knowledge related to subdivision 9.3.

6. Water has a specific heat capacity of 4200 J/kg•°C. How many joules of heat must be added to 400 g of water to raise its temperature from 20°C to 30°C?

   A. 42 J
   B. 168 J
   C. 1 680 J
   *D. 16 800 J

In this question the student is required to apply principles related to subdivision 9.3.

7. When an arrow is shot from a bow, the energy change is from

   A. potential to heat
   B. kinetic to potential
   *C. potential to kinetic
   D. chemical to potential

In this question the student is required to apply principles related to subdivision 9.4.

---

*denotes correct answer

8. The energy of a mass suspended 5 m above the ground is called

A. kinetic
B. chemical
*C. potential
D. mechanical

In this question the student is required to recall knowledge related to subdivision 9.4.

9. The basic difference between atoms of one element and atoms of another is that they contain different numbers of

A. nuclei
B. orbits
*C. protons
D. neutrons

In this question the student is required to recall knowledge related to subdivision 9.5.

10. Why does a coat of paint help prevent iron substances from rusting?

A. The paint forms a smooth surface on the iron.
B. The paint is unaffected by water vapor in the air.
C. A chemical reaction between iron and paint forms a product that doesn't rust.
*D. The paint prevents the iron from coming into contact with water vapor and oxygen in the air.

In this question the student is required to apply principles related to subdivision 9.5.

---

*denotes correct answer

Use the following information to answer question 11.

> A student wants to determine what amount of exposure to light will best help a plant to grow. In his experiment, he exposes five identical plants to light for 3, 5, 7, 10, and 12 h/day respectively for 10 days. Each day he records the height of each plant.

11. The manipulated (independent) variable in this experiment is the

A. type of plant used in the experiment
B. number of days that the experiment requires
*C. amount of light each plant receives each day
D. time of day that the height of each plant is recorded

In this question the student is required to apply the process skill of controlling variables to a given experimental situation.

Use the following information to answer question 12.

> Assuming that the water is uniformly stirred, sugar dissolves more rapidly in water at higher temperatures than in water at lower temperatures.

12. Which experimental design would provide the most reliable data to test such a hypothesis?

*A. Set up four identical beakers of water: W at a temperature of 20°C, X at temperature of 40°C, Y at a temperature of 60°C, and Z at a temperature of 80°C. Use one teaspoon of sugar in each beaker, and time the dissolving.

B. Set up two identical beakers of water: W at a temperature of 20°C, and X at a temperature of 30°C. Use one teaspoon of sugar in each beaker, and time the dissolving.

C. Set up three identical beakers of water all at the same temperature. Put one teaspoon of sugar in each beaker. Heat beaker W over low heat. Heat beaker X over high heat. Do not heat beaker Y. Time each one until the sugar has dissolved.

D. Set up four identical beakers of water. In beaker W, put one teaspoon of sugar. In beaker X, put two teaspoons of sugar. In beaker Y, put three teaspoons of sugar. In beaker Z, put four teaspoons of sugar. Time all four until the sugar has dissolved.

In this question the student is required to evaluate the appropriateness of experimental design for a given hypothesis.

---

*denotes correct answer

APPENDIX: EXPLANATION OF COGNITIVE LEVELS

1. Knowledge

   Knowledge is defined as including those behaviors and test situations that emphasize the remembrance, either by recognition or recall, of ideas, material, or phenomena. This level comprises knowledge of terminology, specific facts (dates, events, persons, etc.), conventions, classifications and categories, methods of inquiry, principles and generalizations, and theories and structures.

2. Application and Understanding

   Application requires that the student apply an appropriate abstraction (theory, principle, idea, method) to a new situation.

   Understanding refers to responses that demonstrate comprehension of the literal message contained in a communication. This means that the student is able to translate, interpret, or extrapolate. Translation refers to the ability to put a communication into another language. Interpretation involves the reordering of ideas (inferences, generalizations, or summaries). Extrapolation is the ability to make estimates or predictions based on an understanding of trends or tendencies.

3. Higher Mental Activities

   Analysis, synthesis, and evaluation are included in the category of higher mental activities. Analysis comprises the ability to recognize unstated assumptions, to distinguish facts from hypotheses, to distinguish a conclusion from statements that support it, to recognize facts or assumptions that are essential to a main thesis or to the argument in support of that thesis, to distinguish cause-effect relationships from other sequential relationships, and to recognize the point of view of a writer.

   Synthesis is the production of a unique communication, the ability to propose ways of testing hypotheses, the ability to design an experiment, the ability to formulate and modify hypotheses, and the ability to make generalizations.

   Evaluation is defined as making judgments about the value of ideas, solutions, and methods. It involves the use of criteria to appraise the extent to which details are accurate, effective, economical, or satisfying. Evaluation includes the ability to apply given criteria to judgments of work done, to indicate logical fallacies in arguments, and to compare major theories and generalizations.

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